Issue 15
April 2018

Utah Valley Amateur Radio Club

The UVARC Shack

On being prepared

Thanks goes to Caryn Alarcon KG7UUR, for setting up an SET (simulated emergency training) TTX (tabletop exercise) for the February meeting.

Thanks also goes to Adam Cowie KI7RED, for coming to our rescue when we got uprooted for the month from our usual location.

In our April meeting, we followed up with another presentation on preparation, this time about relaying messages and getting the word out with a cross-band repeater.

With all of this in place, we're gearing up for service and for fun. But we have our eyes on three looming events: 76ers Barbecue, Utah Valley Swapmeet, and Field Day.

In this issue of the *UVARC Shack*

Two meetings on community service and preparing for the future.

Way to Be for WB1KE. A visit to the shack of KG7UUR, and how she got her start in preparedness. *Brass Tacks* unravels some of the mystery behind transistors. *DIY* explains a different kind of "build-it" in how to set up a cross-band repeater, as demonstrated in the April meeting. *Dear Annette* answers how to get your teen interested in ham radio. *Events* spotlights Utah ham radio clubs.

Please send your ideas, stories, updates, photos, questions, gripes, and breaking news to ***uvarcshack@gmail.com***

Inside this issue

Way to Be	2
My Shack	6
Brass Tacks	7
Dear Annette	12
Events	13
DIY	14
Calendar	20

Other points of interest

- *Utah Valley Swapmeet* 13
- *Utah Clubs and Groups* 13
- *For Your Insight* 19
- *Questions of the Month* 19
- *Lynx* 19
- *Upcoming Contests, Regular Nets* 20
- Ham radio exam sessions / courses 20
- Who we are 21

Way to Be

Spotlight on our members

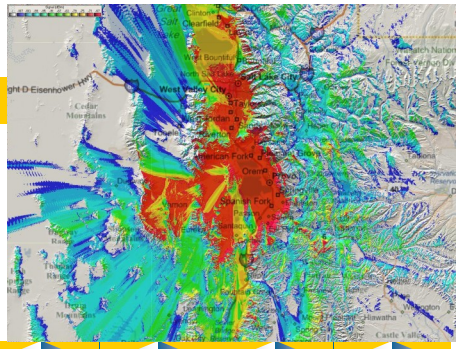
Loren Chandler, WB1KE

Loren has unselfishly volunteered his services to club members in many ways, but one way that's been conspicuous to most of us is the programming of our radios during club meetings. He's supported us during Field Day, in service events, and especially team lunches. On Facebook, Loren has often been one of the first to volunteer his advice or services when a new ham has had the nerve to ask a question or reach out for help.

Loren's technical expertise, coupled with his love of the outdoors and an eye and brain for detail, has led him to become quite the Elmer, extending both his knowledge and his hand of fellowship to experienced hams, youth, and travelers from other states. Please join us in celebrating the work, the generosity, and the example Loren presents to the rest of us.

VHF simplex

What's available



Informed hams often ask about which 2-meter simplex frequency they can use for area nets, events, and personal use. In Utah, there are only 35 simplex frequencies available; one of them is 146.520 MHz, the *National Simplex Calling Frequency*, and another (145.310) is reserved. Here are the rest of them, with the times and weekdays they are used for known nets and such (S = Sun, T = Tue, Th = Thur, Sa = Sat, etc.):

	7:00p	7:30p	8:00p	8:30p	9:00p	9:30p
145.510			S	S		
145.530						
145.550			W-Th		Th	
145.570			S			
145.590				S		
145.610					S-T-Th	
145.630						
145.650			Sa			S
145.670						
145.690						
145.710				S		
145.730						
145.750					S	
145.770				S	S	
145.790						
146.420		S				
146.440						
146.460						
146.480			S	S	S	S
146.500					Th	
146.540		T	S			
146.560			S	S-T	Th	
146.580	S		S	S	S	
147.400			S			
147.420	S			S-Th		
147.440					S	
147.460						
147.480				S-T	S-T	
147.500	W				Th	
147.520					T	
147.540						
147.560						
147.580			S			Th

Programming

Names with the frequencies

When people ask to have their radios programmed, they often don't really know what they're asking, which in many cases is not a problem. All they're really after is an easy way to use their HTs when they need them, without the hassle of remembering a complex matrix of frequencies, offsets, tones, and other features. So, the following charts display the defaults for the frequencies we program into your radios. Settings might vary, depending on radio model.

Utah County

0	146.520	EV-SIM	Emer simp chan - VHF
1	146.760	76ERS	76ers repeater
2	146.780	UVARC	UVARC pri repeater
3	146.620	UARC	UARC repeater
4	147.480	AREA	Area / stake simplex net
5	145.770	CITY	City simplex net
6	147.340	UCARES	UCARES pri repeater
7	147.280	UCAREZ	UCARES sec repeater
8	147.020	L-ERC	Lindon ERC repeater
9	147.120	IMIT	Intermountain Intertie
10	147.080	SINBAD	Sinbad system
11	448.200	UVARC1	UVARC sec repeater
12	449.425	WESTRF	Western Reflector
13	147.340	UC-SIM	UCARES pri simp
14	147.020	ERCSIM	Lindon ERC simplex
15	446.000	EU-SIM	Emer simp chan - UHF
16	154.570	MURS4	MURS channel 4
17	154.600	MURS5	MURS channel 5
18	462.625	FRS18	FRS channel 18
19	462.650	FRS19	FRS channel 19
20	462.675	FRS20	FRS channel 20
21	162.550	WX1	Weather channel 1
22	145.250	SUND	UVARC Sundance rep
23	448.225	AFCYN	UVARC AF Canyon rep
24	145.630	TERT	TERT simplex
25	147.140	MARTY	Marty's repeater
26	145.230	EAGLE	UCARES / Eagle Mtn rep
27	448.875	LEHI	Lehi CERT repeater
28	145.330	BYU	BYU club repeater
29	145.450	BUTTER	Butterfield Peaks rep
30	448.400	IRIDGE	Intermountain Ridge rep
31	155.505	STWIDE	Statewide EMS
32	153.950	UTCO	Utah County emergency

Salt Lake County

0	146.520	EV-SIM	Emer simp chan - VHF
1	146.760	76ERS	76ers repeater
2	146.620	UARC	UARC repeater
3	146.780	UVARC	UVARC primary repeater
4	146.580	AREA	Area / stake simplex net
5	146.560	CITY	City simplex net
6	146.700	SLCARE	SLCOARES pri rep
7	147.520	S-ERC	Sandy ERC simplex
8	147.120	IMIT	Intermountain Intertie
9	147.180	IMIT2	Intermountain Intertie
10	147.080	SINBAD	Sinbad system
11	448.200	UVARC1	UVARC sec rep
12	449.425	WESTRF	Western Reflector
13	449.250	HERMAN	Herriman repeater
14	447.100	SUNCRS	Suncrest repeater
15	446.000	EU-SIM	Emer simp chan - UHF
16	154.570	MURS4	MURS channel 4
17	154.600	MURS5	MURS channel 5
18	462.625	FRS18	FRS channel 18
19	462.650	FRS19	FRS channel 19
20	462.675	FRS20	FRS channel 20
21	162.550	WX1	Weather channel 1
22	146.940	FARNS	Farnsworth Peak rep
23	147.040	FRARY	Frary Peak repeater
24	147.160	ENSIGN	Ensign Peak repeater
25	147.140	MARTY	Marty's repeater
26	145.450	BUTTER	Butterfield Peaks rep
27	448.400	IRIDGE	Intermountain Ridge rep
28	155.505	STWIDE	Statewide EMS
29	153.950	SLCO	SL County emergency

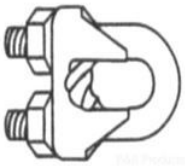
Vendors

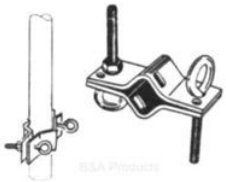
For your convenience

Home Brew Antenna Supplies and Services

MMTD is pleased to offer components to the antenna home brewer!

*Navair (Military Grade) Quality Antenna Hardware
*Insulators *Round and Square Aluminum Booms
*Two and Three Wire Spreaders *Standoffs
*Stainless Steel Clamps in Many Configurations
*Guy Plates *Antenna Grounding Switches
*Bolt Plates in Galvanized, Stainless Steel or Aluminum
*Custom Cooling Chimneys *Grounding Rods
*Delrin, Phenolic and Bakelight Components
*Turnbuckles *Stock and Custom Coils
*Dipole Centers *Aluminum Radials *Grounding Rods





Custom Machining and Welding

For information or a list
email maxfieldmachineTandD@cut.net
or call 801-830-3904

$20, open-stub "Joystick" aluminum half-wave J-pole antenna
by Carl Pockrus, WE7OMG
Half-wave performance, solid construction, weather-proof, low wind-load
Probably the best-performing outdoor antenna you can get for the price
Email at we7omg@gmail.com for purchase or information

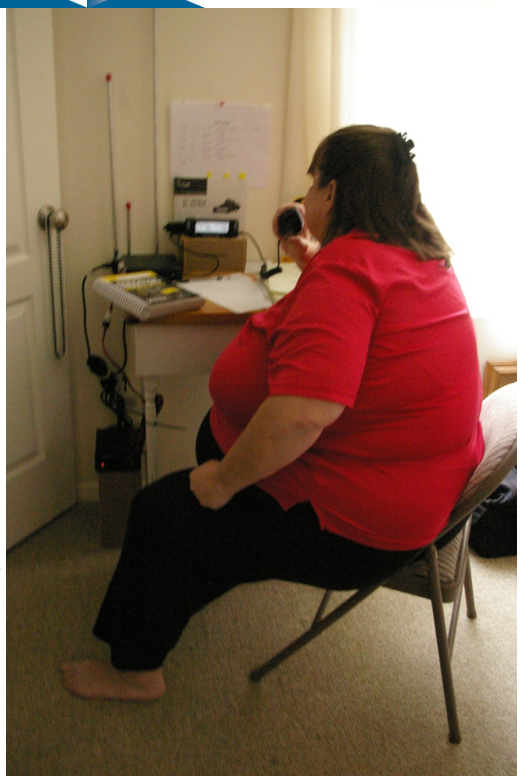
$20, vertical "Super-elastic Signal Stick" quarter-wave flexible antenna
by Richard Bateman, KD7BBC, of SignalStuff (and maker of HamStudy)
Super-performing antenna for your HT (handheld transceiver)
Visit SignalStuff and select SMA-Male, SMA-Female, or BNC

Want your call sign or name (or both!) embroidered on your shirt, your hoodie, your duffle? Or how about a club patch with your call sign?
by Glenna Gardner, WE7SEW
Call sign or name = $5, Both = $8, UVARC patch = $5, Patch with call = $9
Email at glenna0354@gmail.com or call / text 801-592-2503

My Shack

Highlighting the shack (ham equipment and room) of a member, to give others an idea of the possibilities that might work for them

Caryn Alarcon, KG7UUR



What got me interested in ham radio? Well it was my brother Brad KB7DOC, who is very much into being prepared for emergencies. So, he was telling me about ham radio and how it would be a good tool to have just in case there was an emergency, and since I was also CERT trained, I said, What the heck; can't hurt. So, my son and I signed up to take the class in Sandy, and in June 2015 we received our tickets. My name is Caryn Alarcon, better known as KG7UUR, and since that day, I've become very passionate about emergency preparedness and ham radio. I'm a member of UVARC, UCARES, SARC, and RACES. And now I'm a CERT trainer for both Orem and Provo cities.

I truly enjoy getting out into the community and working local events with my radio and attending mock disasters. I've just completed the online *ARRL Emergency Communication* course, and for Christmas this year I received a new radio, an Icom IC-2730A, which has allowed me to create a small ham shack in my room. Now I can check into more nets and monitor frequencies for emergency traffic without freezing in my truck during winter.

My equipment includes

Icom IC-2730A mobile	Kenwood TM-281A mobile
Yaesu FT-60R handheld	Baofeng UV-5R handheld
BTech UV-5X3 handheld	Baofeng BF-F8+ handheld

Dual-band "Pockrus" open-stub J-pole

I love this hobby and all it has to offer. I also enjoy all the people that I meet and socialize with. I'm looking forward to continuing to grow in it, fine-tuning my communication skills, and learning all that I can learn about this hobby, and being ready to serve our community in case of an emergency.

— 73, KG7UUR

Editor's note: Caryn currently serves as the UCARES Membership coordinator, as the UVARC Secretary, and as a CERT Instructor, as she mentioned. Caryn also serves on the SCATeam (Sheriff's Communication Auxiliary Team), and TERT (Timpanogos Emergency Response Team), and as NCS (net control station) for numerous events.

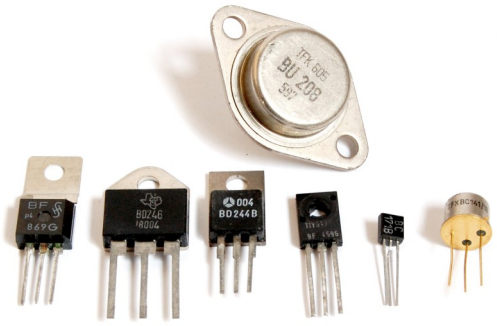
Brass Tacks

An in-depth look at a radio-related topic

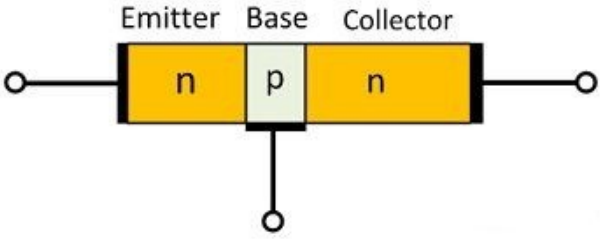
How transistors work

The *transistor* seems to be a mysterious yet indispensable and ubiquitous (found everywhere) electronic component that invisibly performs magic on a circuit very rapidly. If you've ever wondered what transistors really are, or how they work, this might be your chance to get a little insight without having to go back to school. As a caveat, this article will make purists either squirm or smile, because in my attempt to keep the subject matter simple, I'm going to make some generalizations that will hopefully help you understand but not overwhelm you by distracting details of this complex little wonder.

Solid state is the term we use to distinguish between equipment that uses semiconductors instead of vacuum tubes. It's a kind of weird term, because both semiconductors and vacuum tubes are physically solid, not a gas or liquid, although the electron stream in tubes could be thought of as a type of gas or plasma of electrons. At any rate, we use the term solid state to describe transceivers, amplifiers, and other amateur radio equipment that use some semiconductor components rather than vacuum tubes to perform the same or similar functions.



A *semiconductor* device is a term that describes either a diode or a transistor. An *integrated circuit* is a semiconductor component that is made of many transistors, plus other components. Diodes and transistors are very similar in the way they fundamentally work, so let's focus on the transistor. Transistors can be either a bipolar-junction (BJT) or a field-effect (FET) type, and BJTs can be NPN or PNP, but this article will not distinguish between any of them.



Originally, transistors were intended to replace the bulky and energy-hogging vacuum tube, but ironically the first transistors were vacuum-sealed in glass tubes because of their delicate construction. A transistor is made of three pieces of a poorly-conducting material (either Silicon - Si, Germanium - Ge, or Gallium Arsenide - GaAs), one piece sandwiched in between the other two pieces. The middle piece is lightly soaked in a kind of conductive poison, and the two outside pieces heavily soaked in another kind. (In reality, they're just one piece that's *doped* in two different ways, but I'll use the three-piece description to better illustrate how it works.)

This doping allows each piece to conduct electricity under specific situations, but not like a wire, which always conducts, and so we call them semiconductors. In general, a transistor is used either as an *amplifier* or a *switch*, with signal amplification being its original application, so let's start there. For simplicity, I'm going to refer to this three-piece device as a *threesome*, but understand that it merely represents a transistor with its guts revealed somewhat.

Brass Tacks

continued

Amplifier

Let's imagine a simple, crude experiment. If you connect a battery across the two outside semiconductors of our threesome device, current will not flow through the three semiconductors, because the middle one is not conductive in this configuration (Figure 1). Now's when it gets tricky. If you apply a very small voltage to the middle (Base) piece (with respect to the outer piece connected to the negative battery terminal), something starts happening. Invisibly, a small region (in red) of the material in the middle piece becomes conductive, but the region isn't large enough to reach the outer pieces, and so no current flows just yet (Figure 2).

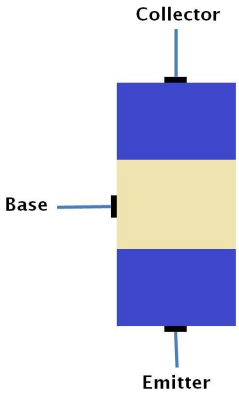


Figure 1

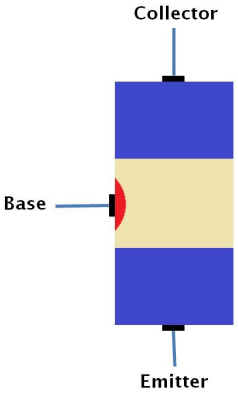


Figure 2

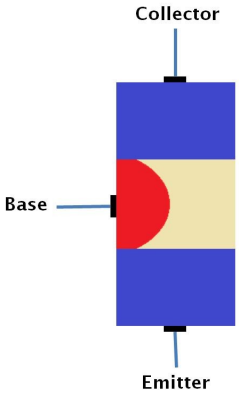


Figure 3

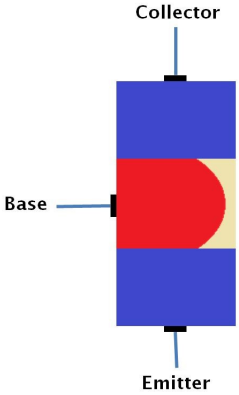


Figure 4

Ok, raise the Base voltage a little more, and the region grows just barely enough to touch both outside pieces, and suddenly current starts flowing through the threesome, from the positive terminal (Collector) to the negative one (Emitter, Figure 3). Raise the Base voltage even more, and even more current flows (Figure 4). It turns out that the current through this threesome is proportional to the voltage you apply to the Base. Furthermore, if you insert a resistor between the battery positive terminal and the Collector (Figure 5), you can measure the voltage across this resistor, which will reflect the change in current through the threesome, which also proportionally reflects the change in voltage applied to the Base.

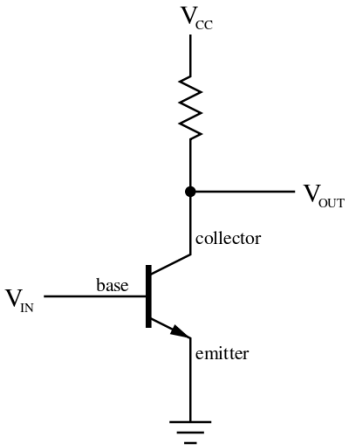


Figure 5

In fact, if the battery voltage is large (think 3 to 5 volts) compared with the voltage you apply to the Base (think 30 to 50 millivolts), it's apparent that the voltage waveform measured across your resistor will be proportional to the voltage waveform you apply to the Base, only much larger. That's the definition of an *amplifier*. And this forms the basis on which a transistor is used in an actual amplifier circuit, which is fundamental to oscillators, detectors, frequency converters, and discrete radio and audio amplifiers.

Brass Tacks

continued

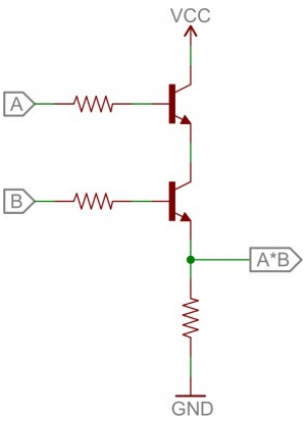
Switch

Now that you know how a transistor can function as an amplifier, let's make two changes to our threesome device. First, let's move the resistor to the other end, between the threesome (Emitter) and the negative battery terminal. Since it's in series with the threesome, it shouldn't make any difference where we place the resistor, but we'll move it for experimental convenience. Next, instead of applying a low voltage to the Base (or *gate* on a FET), let's apply a much larger voltage, one large enough to completely *saturate* the middle piece with the conductive region.

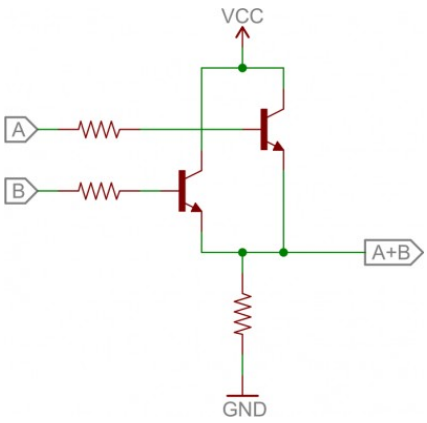
In this condition, the threesome becomes as conductive as it could get. Current rushes through the threesome, through the resistor, to the negative battery terminal, measuring close to the battery voltage across the resistor. Now, reduce the base voltage to near zero, and the resistor voltage goes to zero. This flip between saturation (conduction) and cut-off of the middle piece now acts like an *electronic switch*, and forms the basis for *logic gates*, fundamental to all computer circuitry.

Using this switch configuration, if you connect two of these threesomes in series, it's obvious that close to zero volts will appear across the resistor until both inputs (base voltages) are at full voltage. This is called a logical AND gate, because both input voltages must be at high ("1") voltage in order for the output to present a high voltage. And if you connect these two threesomes in parallel, it should be apparent that the voltage across the resistor will present a high voltage if *either* of the base voltages is at full voltage. This is called a logical OR gate, because either input voltage can be at a high voltage in order for the output to present a high voltage.

By the way, just how fast can these transistors switch, or in other words, how long does it take between the time voltage is applied to the Base, and for the middle section to reach saturation? In today's transistors, anywhere from billionths of a second to trillionths of a second.



Transistor AND gate



Transistor OR gate

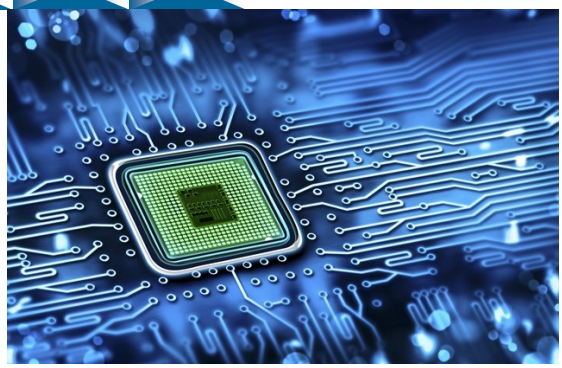
Integrated circuits

The advent of the electronic computer proved to be a remarkable milestone in human history. But dependence on numerous vacuum tubes, which failed at a rate of one to three per day in one of these computers, coupled with the enormous amount of energy required to function, prompted a lot of research into smaller, more reliable, and more energy-efficient computing devices. The invention of the transistor switch completely transformed computers, as well as other electronic devices, into smaller, more efficient, and faster devices with proven reliability many orders of magnitude greater.

Brass Tacks

continued

After a lot of experimentation, it was discovered that transistors can function in saturation / cutoff (on / off switch configuration) even when constructed at sizes much smaller than most discrete components, such as individual resistors, capacitors, and inductors. In applications where they're smaller than can be seen by the human eye, we call these tiny transistors *microelectronics*. And making them that small, we can build huge amounts of logic circuitry made of transistors working together in a package we call an *integrated circuit* or IC.



Today, everyday devices such as cell phones, laptops, GPS, complex medical monitors, and handheld ham radios are now possible because of the multitude of transistors built into microelectronic ICs. And while vacuum tubes were once purchased for $1 to $7 per tube, each transistor can cost under a billionth of a penny, and perform the same function for less than a trillionth the power. In the late 1980s Johnny Carson once joked that, if cars exhibited the same progress as computers, they would now cost a third of a cent, get 50 million miles a gallon, and fit on the head of a pin. Not sure people are laughing anymore, because things everywhere are progressing so rapidly, thanks to the microelectronic transistor.

And speaking of ham radio, newly manufactured rigs of all kinds, from handhelds to base stations, are made with ICs. Transistors have enabled us to embed very complex and fast digital signal processing (DSP) for filtering, digital conversion for ease of signal manipulation, and digital presentation of human controls. In fact many of today's ham radios are nothing less than computers with add-ons, so that much of the processing functions are performed by software or firmware installed in the rig, which we call *software-defined radio* (SDR).

The MOSFET

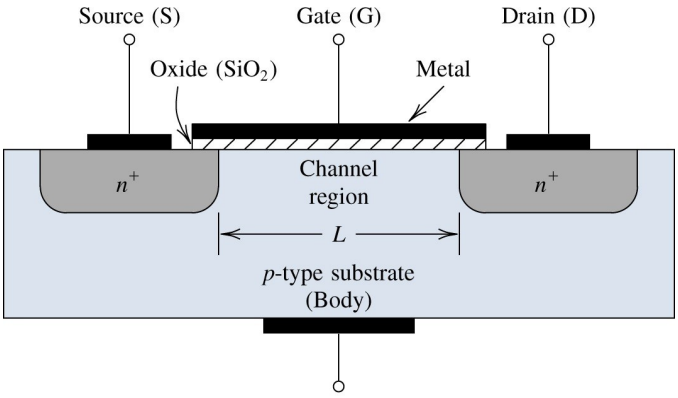
Many of today's computers and other high-tech devices have to rely on small-battery power, which means those many, tiny transistors can't afford to use much energy. For low-power

Brass Tacks

continued

needs, the *MOSFET* (metal-oxide-semiconductor field-effect transistor) was developed to perform the same function as a regular transistor, but at much lower power consumption. The only real difference between a MOS transistor and a regular one (BJT or JFET) is its construction, but the benefits are enormous.

The wire to the Gate of the MOSFET transistor connects to a piece of metal (typically Aluminum), which is deposited on an oxide layer (usually SiO_2), which is then deposited on a semiconductor substrate (usually Silicon), hence the term metal-oxide-semiconductor. Confusion about the meaning of MOS exists because the term often leads people to believe that some sort of metal oxide is involved, but no oxidized metal is involved in today's semiconductors. This construction lends itself to low-power operation because very little current actually passes through the transistor due to the insulating effect of the oxide layer. (SiO_2 is the chemical formula for glass, by the way.)



Metal-oxide-semiconductor construction

There are other types of transistors, some with very specialized functions, but what I've tried to describe is the general workings of the most common types, to give you an idea of how a generic transistor works. Furthermore, because a transistor is built kind of like a pair of diodes that share the same Base, you can test the relative integrity of a transistor by measuring its diode effects between the Base and Collector and the Base and Emitter. But a transistor is more than a pair of diodes, so you can't really make a transistor with a couple of diodes, because they don't share a common substrate, which allows for the field effect that creates the conductive region.

Summary and conclusion

A transistor is an electronic component with three terminals, one connected to each of three sections of a multi-way doped semiconductor, which becomes a good conductor if the middle section (base or gate) has a voltage applied to it. It can act as an amplifier because the conduction of the transistor reflects the varying voltage applied to the base. A transistor can also serve as a switch when the conduction is all the way on or off. Transistor switches form the basis for computer logic circuits, and when made very small, still function well as microelectronics in applications such as integrated circuits.

Because transistors have found their way in nearly every application in daily life, especially in devices that have saved countless lives, it's considered one of the greatest inventions of the 20th Century. What do you think will be among the greatest inventions of the 21st Century?

— Noji Ratzlaff, KNØJI (kn0ji@arrl.net)

Dear Annette

What's on your mind? Serious, humorous, technical, and thoughtful answers to your deepest, (mostly) ham-related questions.

Dear Annette:

How can I get my two teenage daughters more interested in ham radio?

Bugle Boy in Alpine

Dear Bugle Boy:

Probably the most important thing you can give your daughters is your time. *They* know this too, and they treasure the hours that Dad can spend with them, even if it means getting on the radio with you. But your chances of them actually *enjoying* the hobby start diminishing greatly if you wait to share radio time with your daughters until they reach that old, mature teen stretch. And if you're competing with their smart phones, you might find that uphill battle a bit insurmountable. You can try inviting them to check in to the Youth Net or attending Field Day with you. But after inviting them, all your persistent pushing, reminding, and bribery will only drive an uncomfortable wedge between you and them. At that point, I suggest that you let your family watch how much you enjoy your hobby, while you keep their time as your top priority. Then, when and if your daughters get interested, they'll come to *you*.

Dear Annette:

Is it ok to do ham radio on Sunday?

Jax in Eagle Mountain

Dear Jax:

Would it be alright to use your ham radio during an emergency that happens to occur on a Sunday? Does your area / stake participate in a Sunday net? How do you feel about participating in contests or events, such as Field Day, which also spill over into Sunday? In the end, let your conscience be your guide.

Dear Annette:

Do people actually build their own ham radios any more? I'm not talking about low-power CW-only tinker toys that only work on one band. I mean multi-band HF rigs that transmit SSB on 100 watts.

De-parted in Lindon

Dear De-parted:

It's true that building your own 100-watt transceiver has become pretty much a dying art. Most of the higher-powered homebrew projects you'll find are personal ventures. There are a few companies who still make non-QRP kits, such as the Elecraft K2/100. But the K2 price tag ($1200) is one of the reasons for the demise of DIY. At one time you could build your own for much less than buying one off-the-shelf. When famous and long-time kit maker Heathkit went out of business, they explained that the time invested in their superb instructions were as costly as the unit itself. And then there are component considerations. On one hand, you could purchase a kit that has printed circuit boards, complete with SMD (surface-mounted devices) and ICs (integrated circuits) already soldered on for you, leaving you to merely assemble the thing and maybe solder on a couple of parts. On the other hand, you can get hold of schematics so that you can really build from scratch. But that would also mean needing an oscilloscope, signal generator, multi-meter, soldering station, and other costly test equipment. So, they're out there, but mostly by individual crafters, rather than retail manufacturers of kits.

Got a question for Dear Annette*? Send your email to* ***uvarcshack@gmail.com*** *and include your town.*

Events

What's happening in our ham radio community

Utah Valley Swapmeet

Large gathering of amateur radio enthusiasts

The Utah Valley Amateur Radio Club is proud to announce the *2018 Utah Valley Swapmeet*. It will be held on Saturday September 29 from 9 am to noon, in the Ponderosa Room of the Spanish Fork Fairgrounds, 475 S Main St in Spanish Fork. Entry is $5 per person or $10 per family. The typical purpose of a swapmeet is to offer buyers and sellers an opportunity to get together and buy / sell / trade, plus the ability to rub shoulders with long-lost ham friends, and we'll definitely have that. But this swapmeet will also provide the following:

- Demonstrations of amateur radio gear, including helping you get on the air (GOTA station)
- Information on many aspects of amateur radio, including HF, digital, APRS, SOTA, portable, and much more
- Opportunity for many ham radio clubs, social groups, and associations (76ers, Utah VHF Society, UVARC, UARC, UDXA, WDARC, ARRL, etc.) to recruit members
- Chance for service organizations (SLCOARES, UCARES, TCARES, DCARES, TERT, ERC, SAG, ARC, VEC, etc.) to invite and recruit members and inform attendees
- Information about ham radio exam sessions and courses for much of Utah
- Radio programmers who could program your radio on the spot, depending on your radio model and where you live

The website for the Swapmeet is utahvalleyswapmeet.com. We're still hammering out details, but the latest info will be posted on the website, and on FB.

Utah Clubs and Groups

Links and info for Utah ham radio clubs

76'ers Social Group
Bridgerland ARC
BYU ARC
Davis County ARC
Dixie ARC
Golden Spike ARC
Herriman ARC
High Valley ARC (Heber)
Lehi CERT ARC
Lone Peak Communication
Ogden ARC
Rainbow Canyons ARC
Salt Lake Peaks ARC
Sandy ARC
Sevier County ARC
Sinbad Desert ARC
Skyline Radio Club
SL Crossroads ARC
Utah ARC
Utah Valley ARC
Utah VHF Society
Utah DX Association
Wasatch Back Tri-county Amateur Radio Group
West Desert ARC (Tooele)
West Valley City ARC
Others? email *uvarcshack@gmail.com*

DIY

Worthwhile projects you can build on your own

Setting up a cross-band repeater

Some years ago my wife Lisa KR5LYS and I served on the communication committee for our LDS stake during a Mormon pioneer re-enactment trek in Wyoming. Our entire 400-person camp, except for a few crew members, took three days to walk fifteen miles from Martin's Cove to the Sage Campground at Rock Creek Hollow. Pulling handcarts. In the summer heat. In period costumes. And even before we started walking, we noticed a problem.

We were out in the middle of nowhere, so there was no cell service, except at the start, Martin's Cove. Poor kids! There were needs that had to be communicated between the start of the camp and the destination, including food questions, sheltering missteps, and minor medical issues. And the only way that communication could happen was for a crew member to drive the 25-mile one-way route on the dirt and paved roads around to the other end, and back.

As luck would have it, it just so happened that we brought along a mobile unit (Yaesu FT-8800R) capable of what's known as *cross-band repeating*, which means that it can act as a repeater, just like the ones on the mountain that you talk through all the time. (I like to abbreviate it *XBR*, because it's my way of contributing to a world that doesn't have enough acronyms and abbreviations.) Only difference is that this kind of repeater will receive your signal on one band, and re-transmit it on another, which means you and your friend must be on different bands to communicate with each other, in this case 2 meters and 70 centimeters.

Once we set that up, the front of the camp was able to communicate everything they needed with the other end of the camp in seconds rather than hours, thanks to amateur radio. That simple but effective (and inexpensive!) setup amazed many of the crew. The organizers and stake leaders took notice of how useful that was, especially when a medical issue arose, and we had several. So, how did we do it? What did it take for us to set up an XBR? A simple but effective XBR requires a few things, some physical and some operational, so let's start there.

Complete XBR setup, including antenna and battery

As you can see, as far as equipment goes, a basic but powerful XBR includes the mobile rig (dual-watch is best), microphone, antenna, and battery. Since you always plan for inclement weather, place all of this on a table or box in a secured tent. A solar option also works well. I could have set up a tall antenna connected through a coax if I wanted, but for demonstration purposes, this simple setup seems a little clearer.

DIY, continued

Setting up a cross-band repeater

Selecting the frequencies

Since this is a cross-band operation, and the two bands are 2 meters and 70 centimeters, we need to select two frequencies, one from each of these bands, to serve our needs. Sounds easy, but there are rules that govern which frequencies to choose, and satisfying all of them can be a challenge.

First, both of these frequencies must be repeater frequencies, allocated by the Frequency Coordinator according to the Utah Bandplan for repeaters, as the input or output frequencies. The list of allocated repeater frequencies is found on the Utah VHF Society website.

§ 146.70(–)	Salt Lake	WasFrnt	Ensign Peak	KC7IIB	SLCOARES	100.0	O	
§ 146.70(–)	St George	Southwest	Winchester Hills QTH	KA7STK		100.0	OCa	
§ 146.72(–)	Glendale	Southwest	Spencer Bench	WB7REL	Skyline	100.0	OA	447.450 /3576
§ 146.72(–)	Indianola	Central	Indianola Peak	WB7REL	Skyline	100.0	OA	433.650 /3576
§ 146.72(–)	Logan	North	Mt Logan	AC7O	BARC/VHFS	103.5	OXCa	449.625
§ 146.72(–)	East Salina	Central	Salina Canyon	WB7REL	Skyline	131.8	OA	448.275 /3576
§ 146.74(–)	Altamont	Northeast	Altamont	WB7CBS		100.0	OA	
§ 146.74(–)	Enterprise	Southwest	Flattop Mtn	NR7K		100.0	OX	
§ 146.74(–)	Salt Lake City	WasFrnt	U of U Hospital	KD7NX	MARA	114.8	O	
§ 146.76(–)	Cedar City	Southwest	Iron Mtn.	K7JH		123.0	OXCa	
§ 146.76(–)	Moab	Southeast	Bald Mesa	K7QEQ		88.5	OXCaRb	147.320
§ 146.76(–)	Provo	WasFrnt	Lake Mtn State site north end	W7SP	UARC		OXCal	/3352
§ 146.78(–)	Lehi	WasFrnt	Lake Mtn north end	K7UVA	UVARC	100.0	OXA	448.200
§ 146.80(–)	Cedar City	Southwest	Blowhard Mtn.	WV7H		100.0	OX	146.940
§ 146.80(–)	Lava Hot Sp , ID	North	Sedgwick Peak	AE7TA	BARC	88.5	OXA	BARC
§ 146.80(–)	Mapleton	WasFrnt	Mapleton	N6EZO		100.0	O	
§ 146.82(–)	Ogden	WasFrnt	Little Mtn	W7SU	OARC/VHFS	123.0	O	
§ 146.82(–)	St George	Southwest	Utah Hill	NR7K	DARC	100.0	OX	146.940

It's a good idea (not mandatory, but highly recommended) that the frequencies we select be *coordinated* by the Frequency Coordinator for XBR use. In the case of this demonstration, I received written permission from our Frequency Coordinator to use 147.220 MHz and 447.650 MHz, both repeater outputs. But coordinated or not, we need to make sure that both frequencies will not be in use during the time we need them, so we need to test them repeatedly prior to activating the XBR. Listen, then listen some more, then announce *This is K-N-Ø-J-I...is this frequency in use?* on *both* frequencies.

Next, we'll set one side of our dual-band mobile radio to one frequency, and set it for *simplex* operation. We'll set the other side of our mobile radio for the other frequency, also for *simplex* operation. Because both of these frequencies are normally meant for repeater (*duplex*) operation, the mobile radio might automatically assign offsets to them, requiring us to manually override the automatic setting, then setting them to simplex.

Both frequencies entered and set to simplex

Two more things: be sure to set an appropriate power level for each side, and set a tone, as needed. In our demonstration, we've set both sides to low power (the little "L" in the lower-right of each side) because that's all we need. We also set a tone of 100.0 Hz (the "ENC" at the top of each side) to prevent possibly interfering with actual repeaters that require tones that are not 100.0 Hz.

DIY, continued

Setting up a cross-band repeater

Setting the XBR in motion

We're performing this demonstration with a TYT TH-7800, as shown in the photos, because it's simple to set up as an XBR, it's inexpensive, and it's powerful. So, all of these XBR activation instructions will be specific to that rig, although we can apply similar instructions to other modern dual-band mobile transceivers.

Momentarily press the center button (the one with only a white square), then *turn* the upper knob (of the "Main" side) until the display reads "X-RPT" as shown. Momentarily *press* the upper knob so that the display now reads "XSTART" as shown. *Press* the upper knob once more, and the transceiver is now a repeater, and the "Main" symbol disappears altogether, as shown. Instruct all the users of your XBR to tune in to one of the two frequencies, but again setting them for simplex operation, since their HTs might automatically set them with an offset.

Enter the menu and locate X-RPT

Press the knob to select X-RPT

Press once more and it's now a repeater

Staying with our XBR

Once we start our XBR going, according to the rules, ***we must stay near our XBR at all times that it's running in XBR mode***. This is so that we can announce our ID on both frequencies manually (because our XBR is incapable of doing so properly automatically) and so that we can satisfy the rule stating that we must be in immediate control of our equipment at all times it's running.

DIY, continued

Setting up a cross-band repeater

Wait a minute...something's wrong here. What's the *point* of running an XBR if we have to stay with it to manually ID all the time? The primary purpose of XBR is to save time and effort, in this case the effort of recording all those messages between distant stations and then relaying them. When running an aid station on a hilltop, for example, that makes sense, since we'll need to be there anyway, to provide event participants refreshments and medical attention if necessary.

To ID an XBR properly, you must take the repeater offline (take it out of XBR mode), announce your ID on one of the sides, switch to the other side, announce your ID again, then return the transceiver to XBR mode. This is why the transceiver must be accompanied by a microphone.

To exit XBR mode, momentarily press the center button (the one with the single white square). To re-enter XBR mode, repeat the original steps; that is, momentarily press the center button, momentarily press the upper knob (of the "Main" side), then press the upper knob once more.

Baofeng repeater

The mobile transceiver we've been using for this demonstration has built into it the seeming ability to receive a signal and transmit it nearly simultaneously, just like a mountaintop repeater. But it's also possible to create such a "repeater" setup by using a pair of regular handheld transceivers (HTs) that do not have the XBR function built in. At the same time, setting up something like that will help us appreciate the built-in XBR function of our mobile transceiver.

This demonstration seems to work best when using the Baofeng UV-5R series of HT, and we just happen to have a couple of UV-5XP models handy, so we'll demonstrate with those. We'll also need to get hold of a stereo patch cable, with a 2.5 mm plug on one end, and a 3.5 mm plug on the other end. This cable should be at least eight feet long, preferably twelve feet long, but not longer than about fifteen feet, because of the signal loss due to the length resistance. The one we have is nine feet long, far from ideal, but long enough to reasonably separate the two radios and yet maintain signal integrity.

Turn on one of the HTs, which we'll call the *transmitter*, and press the **V/M** button to set it to VFO mode ("Frequency Mode"), then set its upper ("A") display to 147.220. Also, press **Menu** to enter the menu, and locate the "VOX" setting (menu 4). Press **Menu** again to modify the VOX setting, then use the arrow keys to locate setting 10, then press **Menu** to save the setting. Locate the "SFT-D" setting (menu 25) and set it to OFF for simplex operation.

DIY, continued

Setting up a cross-band repeater

Next, turn on the other HT, which we'll call the *receiver*, and set it to VFO mode, then set its upper display to 447.650, but *do not* enable its VOX feature. Be sure to set its "SFT-D" to OFF as well, for simplex operation.

Adjust the power and tone settings as appropriate, and turn off both radios. Plug the stereo cable into the radios, the 3.5 mm plug into the 3.5 mm jack of the transmitter, and the 2.5 mm plug into the 2.5 mm jack of the receiver, placing the two HTs as far apart as possible. Turn on the transmitter, with its volume turned all the way down, then the receiver, with its volume at a comfortable level. Once again, instruct your operators to tune to one of the two frequencies, and set them for simplex operation.

You're all set for XBR operation, but *only for one way*; stations calling in with the receiver frequency will get their signal re-transmitted by the transmitter. To establish two-way communication with our Baofeng XBR, we need to set up two more HTs and a second stereo cable, but in the opposite configuration: set the transmitter to 447.650 simplex, with the VOX set to 10, and the receiver to 147.220 simplex, with the VOX disabled. So, it takes four Baofeng HTs to do the XBR of a single mobile transceiver that's got the XBR function built in, but in the end it'll be a lot less expensive.

Conclusion

If you need to set up your own temporary, little repeater, a simple cross-band repeater might be your solution. Because it's a repeater, it requires the use of repeater frequencies as outlined in the Bandplan, but must in turn be used by your setup in simplex mode only, by both your cross-band transceiver and the stations that communicate with it. The setup is not difficult, especially if you're using a mobile transceiver with the cross-band feature built in, and you need to remain near it.

But if you don't have a cross-band-capable mobile unit, which can be expensive, you can also create a cross-band repeater using a pair of Baofeng handheld transceivers and a stereo cable for each direction. Too fun!

For Your Insight

Information you could use

Club meeting format

Here's the usual agenda for club meetings, at 56 N State St in Orem:

Talk-in frequency on the club repeaters

6:30 pm : Eyeball QSO

socialize / put faces with call signs

radio programmers available to help you

6:45 pm : Call the meeting to order

meeting lineup (agenda)

announcements / nets / awards / calendar

7:00 pm : Discussion / breakout session

discussions usually involve everybody

breakouts split into separate groups

7:45 pm : Door prizes

7:55 pm : Dismiss and tear-down

8:00 pm : *Club QSY* to Lucy's Pizzeria

Something you'd like to see at the meetings?

Monthly meeting help

We're grateful for the volunteers who help with various tasks that make our club night just that much more friendly and useful to everybody. Monthly we need help with

programming radios (thanks, Loren / Ralph!)

taking photos or videos during the meeting

operating the talk-in radio

setting up tables and chairs (thanks, Heath!)

Lynx

Websites for your education and leisure

For the New Ham Radio Operator

Ham Radio Nets

DX Summit and DX Maps

76'ers Group and UVARC Group pages

SOTA and SOTAwatch

Give us your input at uvarcshack@gmail.com

Questions of the Month

Test your knowledge (answers next page)

G8AØ9 : What control is typically adjusted for proper ALC setting on an amateur single sideband transceiver?

A. The RF clipping level
B. Transmit audio or microphone gain
C. Antenna inductance or capacitance
D. Attenuator level

E2CØ4 : What type of transmission is most often used for a ham radio mesh network?

A. Spread spectrum in the 2.4 GHz band
B. Multiple Frequency Shift Keying in the 10 GHz band
C. Store and forward on the 440 MHz band
D. Frequency division multiplex in the 24 GHz band

Calendar

What's happening
(times are Mountain Time)

Utah County Ham Exam Sessions

BYU J. Reuben Clark Law School building

Sign up at HamStudy.org/sessions

Wed April 18, 7:00 to 8:45 pm
Sat April 21, 2:30 to 5:00 pm
Wed May 16, 7:00 to 8:45 pm
Sat May 19, 2:30 to 5:00 pm
Wed June 20, 7:00 to 8:45 pm
Wed July 18, 7:00 to 8:45 pm
Wed August 15, 7:00 to 8;45 pm
Sat September 15, 2:30 to 5:00 pm
Wed September 19, 7:00 to 8:45 pm

Provo One-day Technician Courses

Third Saturday Monthly at 8:00 am
BYU Law School Bldg, First Floor

2018 Orem Ham Radio Courses

Technician : May 22, 29, June 5, 12
General : July 31, Aug 7, 14, 21
Technician : Sept 18, 25, Oct 2, 9

Club Meeting Calendar (6:30 pm)

Orem Council Chambers, 56 N State St

May 3	June 7
July 5*	August 2
September 6	October 4
November 1	December 6*

** Actually a potluck at 93 N 400 E*

Regular Nets

RACES Net, Thu Apr 19 8:00 pm, 147.12
Jackson Hole Net, Mon 8:00 pm, 146.76
UVARC Ladies' Net, Tue 7:00 pm, 146.78
UARC 76'ers, Wed 7:00 pm, 146.76
UVARC Youth Net, Thu 6:30 pm, 146.78
UVARC New Ham Net, Thu 7:00 pm, 146.78
CERT Net, 2nd & 4th Thu 8:00 pm, 146.78
Utah County 6 meters, Fri 8:00 pm, 50.14
6-Pack Net, Fri 9:00 pm, 50.15
Family History Net, Sat 8:00 pm, 146.78
UVARC Singles' Net, Sat 9:00 pm, 146.78
See a larger list of nets at noji.com/nets

Upcoming Contests

State QSO Parties (MS, MO)
FL State POTA *and* ***TX State POTA***
Apr 7 to Apr 8

State QSO Parties (NM, ND, GA)
Apr 14 to Apr 15
State QSO Parties (NE, MI, ON)
Apr 21 to Apr 22
See a larger list at noji.com/contest

Answers to the Questions of the Month

G8AØ9 : **B** (Transmit audio or microphone gain) [Try speaking normally, then loudly while watching your ALC meter, to ensure the output power doesn't overload your finals more than your ALC can compensate]

E2CØ4 : **A** (Spread spectrum in the 2.4 GHz band)

Where everybody knows your call sign

Utah Valley Amateur Radio Club
Orem, Utah, USA

K7UVA
Phone/Text: 801-368-1865
Email: k7uva@arrl.net

Repeaters: 146.780–, 100.0
448.200–, 100.0 224.560–, 100.0

Newsletter input?
Email uvarcshack@gmail.com
Need help?
Email uvarcelmer@gmail.com

We're on the web!
uvarc.club

We are the *Utah Valley Amateur Radio Club*, a 501(c)(3) non-profit (EIN 81-360-6416) Utah corporation that was organized in an obscure Orem fire station on 02-05-2016 to provide amateur radio hobbyists in Utah County and surrounding areas a way to gather and discuss all things ham. Our primary purposes are to provide a local amateur radio resource, help new hams in their new-found adventures, and to give more experienced hams a reason to share their wealth of knowledge and wisdom in a friendly atmosphere of fellowship. We're an ARRL Affiliate and work in cooperation with the Utah VHF Society, but are not subsidiary to them, to UARC, the 76'ers, UCARES, RACES, the SCATeam, or any other organization, although many of our members might also belong to the same.

This alleged newsletter is published every so often by the Utah Valley Amateur Radio Club, and its purpose is to convey the tone and temperament of the club, to inform and entertain its members, and to entice the rest. To join, go to www.facebook.com/groups/uvarc/ and request membership. For more information about our club or about amateur (ham) radio in general, please email or text or call us.

More than just a club, we invite you to become part of a great ham radio movement in Utah Valley

Our fearless leadership

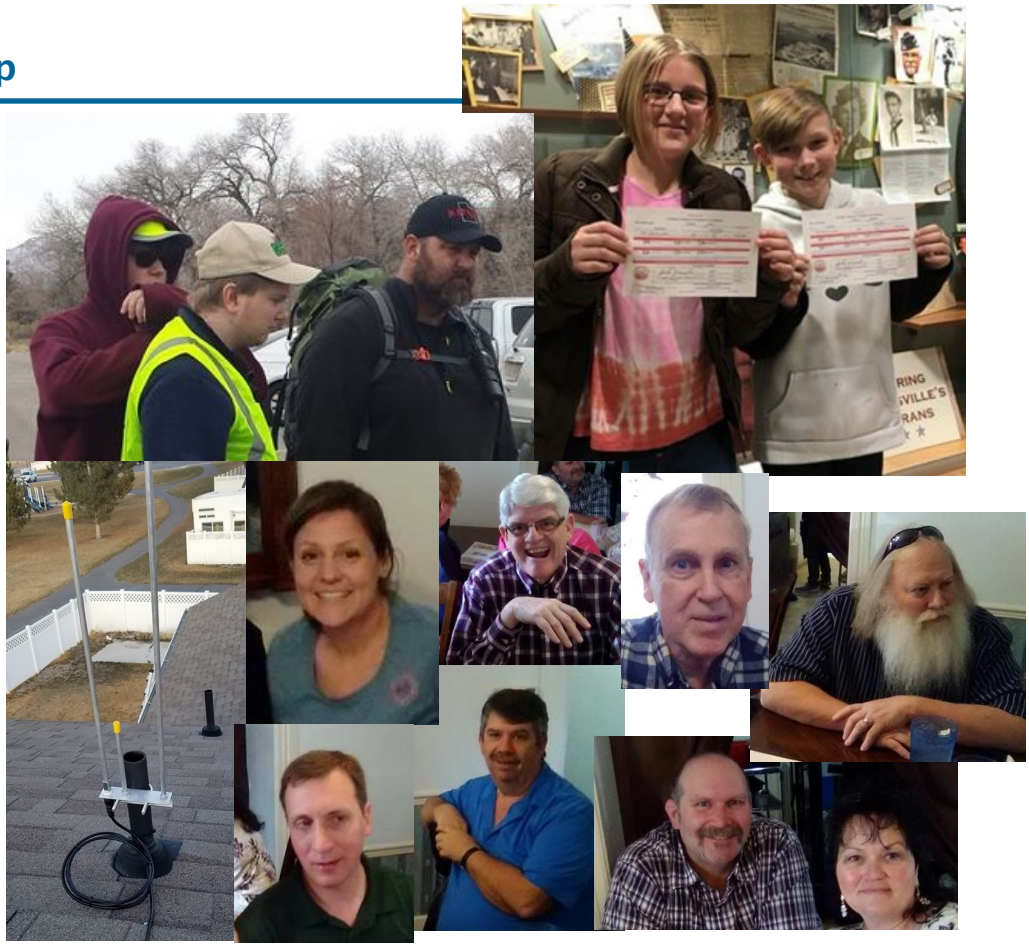
Presidency

President..... Noji Ratzlaff
Vice President..... Chad Buttars
Secretary.....Caryn Alarcon
Activities..... Jeff McGrath
Technology.....Trevor Holyoak

Board of Directors

Richard Bateman, KD7BBC
Carl Pockrus, WE7OMG
Aubrey Gum, K7GUM
Jody Dollar, K7BUX
Jeremy Giovannoni, K7TEH
Brad Kirk, AF7FP
Alma Perry, W1ZGY

Club Sponsor

Heath Stevenson
Orem City Emergency Manager

73